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PR Directorate builds upon HyTech's historic first

by Susan Barone, ASC Public Affairs

WRIGHT-PATTERSON AFB, Ohio—Researchers from the Air Force Research Laboratory's Propulsion Directorate moved into the next stage of development for the Hypersonic Technology program after they successfully ran a performance test engine of an integrated supersonic combustion ramjet using conventional fuels at speeds between Mach 4.5-6.5.

"The PTE met or exceeded all performance goals," said Parker Buckley, chief of the Aerospace Propulsion Office. "It's a historic first in that Air Force and NASA researchers have been working to develop a practical and operable scramjet for four decades."

Program officials are now in the process of designing the ground demonstrator engine. Near term application for this technology is to power a hypersonic cruise missile that is capable of flying at speeds between Mach 4 and Mach 8, and yet small and light enough for fighter and bomber aircraft to carry. The missile would destroy time-sensitive or time-critical targets at extended ranges.

"The aircraft that would launch these weapons could potentially strike targets deep in enemy territory without ever having to penetrate enemy air defenses," said Robert Mercier, deputy for technology for the Aerospace Propulsion Office of AFRL's Propulsion Directorate. "A conventional weapon has a much lower speed, so the warfighter would have to fly very close to the target for it to be effective."

Looking to the future, Mercier said that the technology has long-term applicability to provide affordable access to space that could potentially be made on-demand by having a launch vehicle that would operate much like an airplane.

The PTE test was the first time a scramjet has successfully run on ordinary jet fuel. In the past, exotic, expensive and often toxic fuels were used to sustain combustion.

"Other scramjets have used hydrogen, which is a highly reactive fuel," said Mercier. "The military prefers more logistically-supportable fuels, such as the JP-7 that was used on the SR-71."

The latest major program involving scramjet propulsion ended in 1995 with the cancellation of the X-30, National Aero-Space Plane development. After the X-30 program was terminated, two programs were started: NASA's Hyper-X, which seeks to demonstrate hydrogen-fueled scramjets and the Air Force's HyTech program, which aims to demonstrate a hydrocarbon-fueled (i.e., jet fuel) scramjet that can operate from Mach 4 to Mach 8 without the use of ignition enhancement devices.

Engineers are building on the lessons learned during PTE and engine component structural durability tests.

"Our success and lessons learned to date give us confidence to move forward to the next stage of the program—testing of the GDE," said Mercier. "The GDE is where the performance and structural lessons learned are brought together."

AFRL's Propulsion Directorate engineers conducted fuel mixing and injection studies in the scramjet research facility—test cell 22. One of the key challenges of the study included mixing the fuel with the air as it went through the engine.

"The in-coming air moves through the engine pretty quickly," said Terry Ronald, HyTech deputy, now emeritus. "The challenge is that you have to inject fuel into that air stream and ignite it, getting the fuel to mix with the oxygen in the air and burn and do that all in the time it takes for the air to move through the engine, which is approximately less than a millisecond."

"The analogy would be that it is like lighting a match in the middle of a blowing hurricane," said Mercier.

The PTE was made out of copper for its ability to absorb and dissipate excess heat, while the walls of the GDE are made of a high temperature steel alloy and have passages in the walls through which jet fuel flows, absorbing heat from the engine and keeping the wall temperatures below acceptable limits.

"The engine structure will be the same as a flight engine, but will be sized to withstand facility start loads

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and would be a little heavier than the final flight engine," Mercier said. "The ground demonstration engine will be made out of flight weight materials and structural shapes that also will be cooled with the fuel, just like it will be on the vehicle," said Ronald.

AFRL Propulsion Directorate officials say the GDE will be tested in the next year and they hope to have a complete flight-ready engine demonstrated by 2004. **@**